

### **REMARKS**

By this Amendment, Applicants have amended claims 1 and 6 to more appropriately define the present invention and added new claims 20-23 to protect additional aspects of the invention. In making each of these amendments, Applicants submit no new matter has been added.

As a result of this Amendment, claims 1-6 and 20-23 are pending.

In the Office Action, the Examiner rejected claims 1-6 under 35 U.S.C. § 103(a) as being unpatentable over Masataka (JP 11-271965 Patent Abstracts of Japan and partial machine translation) in view of Sato et al. (JP 08-262721 Patent Abstracts of Japan).

Applicants respectfully traverse the rejection of claims 1-6 under 35 U.S.C. § 103(a) as unpatentable over Masataka in view of Sato et al. Applicants respectfully disagree with the Examiner's arguments and conclusions, and respectfully submit that a *prima facie* case of obviousness has not been established.

In order to establish a *prima facie* case of obviousness, three basic criteria must be met. First, the prior art reference (or references when combined) must teach or suggest all the claim elements. Furthermore, "[a]ll words in a claim must be considered in judging the patentability of that claim against the prior art." See M.P.E.P. § 2143.03, 8<sup>th</sup> Ed., Aug. 2001, p. 2100-126, quoting *In re Wilson*, 165 U.S.P.Q. 494, 496 (C.C.P.A. 1970). Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to

modify a reference or to combine reference teachings. Third, there must be a reasonable expectation of success. See M.P.E.P. § 2143, pp. 2100-122 – 2100-127.

The Examiner does not show that all the elements of Applicants' claims are met in the cited references, taken alone or in combination, does not show that there is any suggestion or motivation to modify the cited references to result in the claimed invention, and does not show there would be any reasonable expectation of success from so doing.

Claim 1 recites, among other things, "[a] pattern formation method for electron beam lithography ... wherein said pattern formation material further comprises first and second dissolution inhibiting groups each of which has a capacity of inhibiting dissolution of said alkali-soluble resin in an alkali solution and loses the capacity upon application of an acid, said first dissolution inhibiting group increasing a sensitivity of said pattern formation material when left to stand in a vacuum after being irradiated with an electron beam, and said second dissolution inhibiting group decreasing the sensitivity of said pattern formation material when left to stand in a vacuum after being irradiated with an electron beam ... ."

Masataka and Sato et al., taken alone or in combination, do not teach or suggest at least these elements of Applicants' independent claim 1.

First, the Examiner admitted deficiencies of Masataka, by alleging Sato et al. discloses "a positive type resist composition having a high sensitivity, high resolution, and high heat resistance, excellent in aging stability, and capable of forming a resist pattern excellent in profile shape" (Office Action, p. 2), to compensate for teachings

lacking in Masataka. Thus, it is established that Masataka does not teach or suggest all of Applicants' claimed elements.

In addition, Applicants further distinguish the present claimed invention from Masataka: While Masataka discloses coating a chemically amplified resist containing a polymer having an acetal-type acid dissociation group on a substrate to form a resist film and then electron beam ("e-beam") exposing the resist film in a vacuum (Masataka, "SOLUTION" portion of the Abstract), Masataka does not teach or suggest at least the claimed combination of "said first dissolution inhibiting group increasing a sensitivity of said pattern formation material when left to stand in a vacuum after irradiated with an electron beam, and said second dissolution inhibiting group decreasing the sensitivity of said pattern formation material when left to stand in a vacuum after irradiated with an electron beam." In addition to the Examiner's admitted deficiencies regarding Masataka, it is also clear that Masataka does not teach or suggest at least the elements of Applicants' claim 1 quoted above.

Moreover, contrary to the present claimed invention, Masataka relies on atmospheric exposure of the resist pattern as a necessary step in the resist pattern forming method, vis-à-vis "[t]he resist film 12 subjected to the pattern exposure is *transferred from the inside of the vacuum into an atmosphere of about 50% in humidity and is rested for a suitable time*, for example, 5 seconds in the atmosphere to humidify the resist film 12..." (Id. at SOLUTION, emphasis added). In addition, Masataka's paragraphs [0015] through [0020] further demonstrate the need for moisture absorption in atmosphere to facilitate desorbing the "acetal type acid leaving group" as the resist

film is left to stand in humid air between electron beam exposure and post-exposure baking. Therefore, Applicants' independent claim 1, exemplary portions of which were quoted above, is clearly distinguishable over Masataka, which relies on atmospheric exposure of a resist pattern.

Further, Applicants' independent claim 1 recites a pattern formation material comprising, *inter alia*, a ratio of said first dissolution inhibiting group to said second dissolution inhibiting group is adjusted such that a size of an alkali-soluble portion, which is a portion made soluble in said alkali solution when said pattern formation material is irradiated with an electron beam, is substantially held constant independently of a standing time in a vacuum.

Applicants respectfully submit that Masataka and Sato et al., taken alone or in combination, do not teach or suggest at least the above-mentioned elements of claim 1. As discussed above, Masataka does not teach or suggest a combination of at least a chemically amplified resist that increases its sensitivity when left to stand in a vacuum after electron-beam writing, with the chemically amplified resist that decreases its sensitivity when left to stand in a vacuum after electron-beam writing. Therefore, Masataka, necessarily, does not teach or suggest at least the claimed ratio of a first dissolution inhibiting group to a second dissolution inhibiting group, as claimed.

The Examiner attempted to cure the deficiencies of Masataka, noted above, by alleging that "it would have been obvious to ... prepare the material of [Sato] by the

method of [Masataka]...” (Office Action, p. 3).<sup>1</sup> Applicants dispute the Examiner’s allegation, and note that while Sato et al. discloses a chemically amplified resist composition containing polyhydroxystyrene in which tert-butoxycarbonyloxy groups substitute for 10-60 mol% of hydroxyl groups, and polyhydroxystyrene in which predetermined residual groups substitute for 10-60 mol% of hydroxyl groups (See Sato et al., Abstract, copy in English provided by the Examiner), Sato et al.’s paragraph [0007] (an English version of which is provided in the attached Appendix) teaches “[the conventional chemically amplified resist has] a problem of deterioration in pattern shape (aging stability) which is unique to chemically amplified positive resists, which is due to the deactivation of acid produced by light exposure, and which occurs when the resist is subjected to a light exposure, left for a certain period, and developed.”

Contrary to the present claimed invention, the “aging stability” described in Sato et al. merely refers to the effect of air exposure time on the pattern shape of the resist film during the period between the light exposure and post exposure bake. This is clearly evidenced by the description of the light exposure by use of deep-UV and excimer laser beams described in paragraph [0007], which is a process executed in air.

Further evidence stems from the description in paragraph [0007] of Sato et al. wherein it discloses “a problem of deterioration in pattern shape (aging stability) ... is due to the deactivation of acid.” Id. at paragraph [0007]. The “deactivation of acid” mentioned in Sato et al. is neither a physical phenomenon such as diffusion of acid in a

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<sup>1</sup> Applicants assume the Examiner meant “the material of Sato by the method of Masataka,” as the Office Action instead stated “the material of Masataka by the method

resist film nor a chemical phenomenon in which the acid is used as a catalyst. In a chemically amplified resist, the acid functions as a catalyst. Thus, in general, this acid does not by itself react with another compound included in the resist. Therefore, the “deactivation of acid” of Sato et al. must occur by the reaction of the acid with a compound supplied by the atmosphere in which the resist is situated. In fact, it is well known to a person skilled in the art, that the acid in the chemically amplified resist of Sato et al. is deactivated by the reaction with the amines included in air.

Still further, Sato et al., in paragraphs [0089] and [0090], discloses that pattern shapes are compared in a situation where post exposure bake (PEB) is performed immediately after light exposure with a situation where PEB is performed thirty (30) minutes after the light exposure. Sato et al. further discloses that excellent profiles are formed in the latter situation. Therefore, the “deactivation of acid” occurs within thirty minutes of exposure of resist to air.

Therefore, it is clear from the above-referenced passages of Sato et al. that the “deactivation of acid” is a characteristic related to exposure time of the resist to air between the light exposure and PEB, and is not in any way related to the “decreasing the sensitivity of said pattern formation material *when left to stand in a vacuum* after being irradiated with an electron beam,” as claimed. (emphasis added).

Turning now to the second criteria for establishing *prima facie* obviousness, Applicants submit that the Examiner has not demonstrated the existence of any reasonable suggestion or motivation, either in Masataka, Sato et al., or in the

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of Masataka.” See Office Action, p. 3, l. 15.

knowledge generally available to one of ordinary skill in the art at the time the present invention was made, to modify Masataka or Sato et al., or to combine their teachings. Applicants again note the requirement that “[t]he prior art must provide a motivation or reason for the worker in the art, without the benefit of appellant’s specification, to make the necessary changes ...” M.P.E.P. § 2144.04, p. 2100-133, internal citation omitted.

As previously established, Applicants have noted that Sato et al.’s paragraph [0007] teaches the problems associated with conventional chemically amplified resists in that they experience a deterioration in pattern shape from poor aging stability. Sato et al.’s resist composition improves aging stability. (See Sato et al.’s ¶[0007]) Applicants also argued that Sato et al.’s “deactivation of acid” is brought about not from acid diffusion, but from the interaction between amines existing in the atmosphere and an acid at the time of exposure. Moreover, the “deactivation of acid” cannot occur in a vacuum containing no amines. Thus, aging stability is a problem arising when light exposure is not performed in a vacuum, and has no relation to the problems solved by the present invention. Furthermore, the teaching away noted above clearly demonstrates that there would not be any reasonable expectation of success from combining Masataka with Sato et al. to produce Applicants’ claimed invention.

Furthermore, as discussed previously, Masataka discloses that in the process in which an electron beam is used for pattern exposure of the chemically amplified resist film, the air exposure time of the resist film in the period between pattern exposure to PEB is about 5 seconds. This short period of exposure to air, namely, few seconds, is insufficient to give rise to a problem of “aging stability” as described in Sato et al.

Therefore, there is no motivation to combine the teachings of Sato et al. with those of Masataka.

Moreover, in the Office Action, the Examiner states that “one of ordinary skill would have been motivated to maximize the ratio of the two groups to achieve the best image profile.” Office Action at page 4. Applicants respectfully disagree with the Examiner’s allegations.

First, the Applicants discovered an aspect of the invention is that the dimensions of a resist pattern are significantly different between the writing start and end positions due to the diffused state of an acid during the required long exposure time. See Specification, page 6, lines 15-27 and page 7, lines 10-24. Further, the Applicants discovered another aspect: that when a general chemically amplified resist is left to stand in a vacuum after electron beam writing, the acid diffuses to increase the sensitivity of the material. Specification, page 12, lines 7-10.

In conjunction with the above discoveries, Applicants’ claimed invention recites, among other things, a first dissolution inhibiting group increasing a sensitivity of said pattern formation material when left to stand in a vacuum after irradiation with an electron beam, and said second dissolution inhibiting group decreasing the sensitivity of said pattern formation material when left to stand in a vacuum after irradiation with an electron beam. Thus, one skilled in the art would only arrive at the present claimed invention by consulting the Applicants’ disclosure. Therefore, the only way to construct the claimed invention from the cited references would be to rely on the aforementioned



aspects related to the present claimed invention. Such reliance, however, would constitute improper hindsight reasoning.

This, taken in combination with Masataka's requirement for humid atmospheric exposure of the resist, clearly demonstrates that there is no suggestion or motivation within either reference to produce Applicants' claimed invention. Masataka teaches the need for humid atmospheric exposure of the resist, and Sato et al. also requires an atmosphere to facilitate interaction between amines existing in the atmosphere and an acid at the time of the resist exposure. These teachings alone demonstrate that Masataka and Sato et al. actually teach away from the features set forth in Applicants' independent claim 1, and therefore neither reference can teach or suggest the claimed *combination* of at least a chemically amplified resist *that increases its sensitivity when left to stand in a vacuum after* e-beam writing, with the chemically amplified resist *that decreases its sensitivity when left to stand in a vacuum after* e-beam writing.

Finally, for the third criteria required for establishing *prima facie* obviousness, the Examiner has not shown there would be any reasonable expectation of success derived from combining Masataka and Sato et al. Applicants submit that Masataka's teachings of atmospheric exposure, and the fact that Sato et al.'s acid deactivation cannot occur in a vacuum containing no amines, demonstrate that there would be no reasonable expectation of success to be derived from substituting Sato et al.'s polymer into Masataka, as both inventions dictate atmospheric exposure of the resist, which still would not produce Applicants' claimed invention. Even if Masataka and Sato et al. were combined, the resist sensitivity cannot be kept constant during electron beam writing,

and one of ordinary skill in the art would not expect a successful result from Masataka and Sato et al.'s combination, because, without exposing the resist to atmosphere, Masataka and Sato et al.'s results cannot be obtained, and this steers one away from producing Applicants' claimed invention.

In summary, the Examiner has therefore not met the essential criteria for establishing a *prima facie* case of obviousness for claim 1. Applicants have demonstrated above that the Examiner: (a) has not shown all elements of Applicants' claimed invention are taught or suggested by Masataka or Sato et al.; (b) has not shown any requisite motivation to modify Masataka or Sato et al. to produce Applicants' claimed invention; and (c) has not shown there would be any reasonable expectation of success from modifying Masataka or Sato et al. in order to produce the present claimed invention. Thus, Applicants submit that the Examiner's reliance on Masataka and Sato et al. fails to establish *prima facie* obviousness.

Accordingly, the rejection of claim 1 under 35 U.S.C. § 103(a) is improper, and Applicants respectfully request the Examiner to withdraw the rejection of claim 1 and the claim allowed. Claims 2-5 are also allowable at least in view of their dependency from allowable claim 1.

Claim 6, although different in scope, includes recitations similar to allowable claim 1. For at least the reasons mentioned above regarding claim 1, the Examiner has failed to make a *prima facie* case of obviousness for claim 6. Therefore, the rejection of claim 1 under 35 U.S.C. § 103(a) is improper and Applicants respectfully request the Examiner to withdraw the rejection of claim 6 and the claim allowed. New claims 20-23

depend from allowable claim 6 and, therefore, are also allowable at least in view of their dependency therefrom.

Please grant any extensions of time required to enter this paper and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

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Dated: May 12, 2004

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**APPENDIX TO AMENDMENT OF May 12, 2004**

**PARTIAL TRANSLATION OF SATO, ET AL. (JP 08-262721)**

Paragraph [0007]

The conventional chemically amplified positive resist, however, is unsatisfactory in practical use because it does not have enough light transmittancy as it greatly absorbs rays, especially deep-UV and excimer laser beams, it is not sufficient in sensitivity, resolution and heat resistance, and it has tendency to bring about a resist pattern having a cross section whose upper portion is wider. Furthermore, the resist has a problem of deterioration in pattern shape (aging stability) which is unique to chemically amplified positive resists, which is due to the deactivation of acid produced by light exposure, and which occurs when the resist is subjected to a light exposure, left for a certain period, and developed. Moreover, the conventional chemically amplified positive resist has dependency to a substrate and may form a resist pattern with a hemming bottom in the case where a certain kind of substrate is used.